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ABSTRACT

This document proposes a program in sustainable technology at Maui Community College (Hawaii). This new career program would be designed to provide four Certificates of Competence, a Certificate of Achievement, and an Associate in Applied Science degree. The primary objectives of the program are to meet student, county, and state needs for pre-employment entry- and intermediate-level skills, as well as in-service training in implementing energy-saving systems in buildings and structures. Specific learning objectives of the program include: (1) knowledge and skills on the design, construction, and repair of "green" buildings that employ energy conservation methods, recycled construction materials, and such renewable power as wind, sun, water, and other sustainable energy; and (2) skills in the use of biomass energy equipment, computer-controlled equipment, and related diagnostics for reducing electricity consumption. The sustainable technology program will support major state and county initiatives to diversify the economic base and to attract clean, high-technology industries. Both the Department of Labor and Industrial Relations data and the community needs assessment results substantiate the need for a sustainable technology program in Maui County. Appendices contain program description; Labor Department employment outlook; community needs assessment; indication of student demand; sustainable technology faculty listing; planned resources; projected assessment of program efficiency; comparative costs per student semester hour; community advisory committee list; and community letters of support. (JA)

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ED 454 913

UNIVERSITY OF HAWAI'I
Maui Community College

Program Proposal

Certificates of Competence
Certificate of Achievement
Associate in Applied Science Degree

in

Sustainable Technology

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Program Proposal

1. *What are the objectives of the program?*

The Sustainable Technology (SUSTECH) program, designed with four (4) Certificates of Competence, a Certificate of Achievement, and an Associate in Applied Science degree, is proposed as a new career program at Maui Community College. The primary objectives of the program are to meet student, County, and State needs for pre-employment entry and intermediate level skills as well as in-service training on implementing energy-saving systems in buildings and structures.

Specific learning objectives of the program include:

- Knowledge and skills on the design, construction, and repair of "green" buildings that employ energy conservation methods, recycled construction materials, and such renewable power as wind, sun, oceans, and other sustainable energy.
- Skills on the use of biomass energy equipment and the use of computer-controlled equipment and related diagnostics for reducing electricity consumption.
- Strong theoretical background in the field of electricity and electrical power production and management as a basis for student adaptation to rapid changes in the field of energy conservation.

The Associate in Applied Science degree for Sustainable Technology will build upon the Certificate of Achievement, which builds upon the Certificates of Competence in a career-ladder sequence. Program students in all certificate and associate levels will complete a series of core requirements. Specific program competencies and curriculum requirements are listed in Appendix A.

2. *Are the program objectives appropriate functions of the College and the University?*

The program objectives are appropriate functions of the College and the University as they are consistent with:

- The mission of the University system, the UH Community Colleges, and the approved academic development priorities of the College.
- The provision of a skilled workforce for initiatives to diversify the economic base of the State and County and to reduce the islands' dependence on oil-based energy.
- The need for a labor force with the skills taught by the program.

The College mission is consistent with the mission of the UH Community Colleges. In a *Statewide System and Beyond: A Master Plan for the University of Hawaii* (July 1991), the clearly stated mission of the UH Community Colleges is to provide career and technical programs which prepare students for immediate employment and provide the trained work force needed by the State (MasterPlan, p.32). The proposed Sustainable Technology program supports this mission by providing needed technically trained employees and by taking advantage of the College's ability to provide outreach education to the three islands of Maui County through the use of its distance education delivery systems.

In the discussion of its *1990-1996 Academic Development Plan* priority "to develop new instructional programs in response to community needs," the College identified the requirement for a Community Needs Assessment to ascertain the possible demand for a Sustainable Technology program. The purpose was to assess the needs in Maui County for a program of instruction in building and maintaining energy-efficient systems, in light of the state's dependence on shipping in fuel for energy production. The *1996-2002 Academic Development Plan* reaffirms this objective and reports progress on seeking the authorization to plan a Sustainable Technology program.

The Sustainable Technology program will support major State and County initiatives to diversify the economic base and to attract clean, high technology industries *(Overall Economic Development Plan, County of Maui*, October 1994, pp. 32-63). Development of the Maui Research and Technology Center and the Maui High Performance Computing Center, which became operational in 1992 and 1994 respectively, moves the economy significantly closer to such diversification. These two entities are already attracting new technologically based businesses and industry to Maui. Hawaiian Commercial and Sugar Co., a mainstay of the island economy, is diversifying its economic base with production of a dura-board from bagasse and other by-products of sugar cane. Dura-board is used in the construction of "green" buildings and lessens the state's dependence on imported lumber. Construction waste and substandard product can be recycled at the plant to make more new product. HC&S needs more bagasse or another crop to produce this product. Its new plant at Puunene will require 20 workers for production and sales when the operation reaches full scale. The company will continue to use biomass to generate electricity for its own consumption and sell the excess to the Maui Electric Company.

There are a number of Maui companies and consumers who are moving to sustainable systems in view of incentives to reduce consumption of oil-based energy. The Public Utilities Commission has required the Maui Electric Company to implement an Integrated Resource Plan (IRP), to integrate renewable systems into the power grid. MECO has implemented a plan whereby all commercial establishments that complete an approved demand-side management (DSM) program are eligible for rebates on their electricity bills. Residential customers may participate by installing a solar water heater and/or solar electric system according to MECO standards. Other options include the installation of approved renewable (e.g., photoelectric, wind, water) systems that generate electricity -- thereby reducing

one's utilization of MECO power -- and then selling any excess production to MECO for consumption by others. Major hotels and commercial establishments are already in the process of instituting energy management systems for their physical plant; and many residential customers are integrating solar power. There is a shortage of persons skilled in the installation, retrofit, maintenance, and repair of systems using sustainable technology that meets MECO standards and the building cord.

While the number of new jobs and the number of jobs available due to separations in the area of sustainable technology are currently moderate, there is a growing need for both pre- and in-service training. During the coming decade the demand for sustainable-trained technicians will grow. The College expects this need to expand more rapidly as energy conservation measures on the island, in Maui County, and the State of Hawaii grow and expand.

Early assessment of the demand for sustainable-trained employees was carried out through data generated by the Research and Statistics Office of the state Department of Labor and Industrial Relations. The employment demand projected over a 10-year period for sustainable-related job descriptions was extracted from *Employment Outlook for Industries and Occupations, Maui County, 1996 – 2006* and is presented in Appendix B. In brief, the data project more than 1140 openings in Maui County and 4,540 statewide over the next 10-year period in sustainable-relevant fields.

To verify the need identified by the state employment service, the College completed its own analysis. The purpose of the Community Needs Assessment was to assess the demand for persons knowledgeable in:

- The design, construction, retrofit, maintenance, and repair of "green" buildings using energy efficient systems, such as day-lighting, passive cooling, and use of recyclable construction materials.
- The installation, function, and repair of sustainable energy systems derived from wind, sun, water, or other renewal power.
- The installation, service, and repair of electricity-saving equipment using new technology such as off-grid systems or computer-controlled consumption and diagnosis.

A *Community Needs Assessment* survey instrument was developed and field-tested in early April 1997. In April questionnaires were mailed to all potentially-relevant Maui business, industry, and government entities (n=443) including building, electrical, and plumbing contractors, architects, automotive repairers, hotels, power generator companies, waste disposal companies, and agriculture businesses. Fifty-four surveys were returned for a return rate of 12.2 percent, a comparable rate of return for this type of mass mail survey. The questionnaire, procedures, and results of the *Community Needs Assessment* for this program are included in Appendix C.

The Community Needs Assessment showed an employment demand for new hires as high from expansion of operations as from replacement of out-going employees.

- Thirty-four (34) companies are able and willing to hire potential graduates of a Sustainable Technology program in the next five years.
- The number of anticipated new employees is sizable (114) over the next five years. The projected annual need for 22.8 new hires a year compares favorably to the potential capacity of the Sustainable Technology program for preparing 15 new employees per year, given a class size of 15 students attending full-time.
- All firms anticipated paying new hires with Sustainable Technology skills well above the minimum wage -- starting at $8 or more per hour. Willing to start higher at $8-$15/hour were 49 percent of the respondents, while 32 percent indicated they would pay the even higher wage of $15-$25/hour, and another 19 percent would pay $25 or more per hour.
- The expressed in-service demand was substantial. Respondents claimed enough employees would benefit from the various in-service courses to fill 597 seats.

Both the Department of Labor and Industrial Relations data and the Community Needs Assessment results substantiate the need for a Sustainable Technology program in Maui County. There is a fundamental and increasing concern that there will be a shortage of residents with the basic technical education required to successfully compete for emerging science and technology employment opportunities. This problem is especially pronounced among the Hawai`i indigenous population and other minority groups who are already underrepresented in technical occupations. The proposed program will provide the only educational program of its type in Maui County and in the State. For Maui County residents desiring employment in the field, there are few opportunities to learn the requisite knowledge and skills at this time. To acquire these requisites, citizens of Maui, Molokai, and Lanai need to leave their island, state, family, and job.

3. *How is the program organized to meet its objectives?*

The proposed program, administered by the Dean of Instruction through the Sustainable Arts and Technology Unit, is based on the competencies identified by advisory committee members, partners in the community, and the National Renewable Energy Laboratory (NREL). The program has been reviewed and passed through the Vocational-Technical Division (now Sustainable Arts and Technology Unit), the College Curriculum Committee, the Academic Senate, and the campus Administration. The proposed program name follows the current industry usage for the technology covered.

The curriculum is organized to meet its major purpose of providing entry and intermediate level job skills as well as a solid theoretical and hands-on foundation for students who choose to directly enter the work environment. Students begin with five core courses that develop the basic knowledge related to installation, diagnosis, and repair of sustainable systems, energy management systems, energy production

systems, energy storage and control systems, and biomass energy processes. Hands-on experience is achieved through internships at the College and with community businesses. The program provides for Certificates of Competence exit points in the four major areas, with each certificate requiring satisfactory completion of on-the-job internship experience:

- energy management
- energy production
- energy control
- biomass energy processes

The Certificate of Achievement in Sustainable Technology will career ladder upon the four Certificates of Competence by requiring 14 additional credits in electrical theory, safety concerns, mathematics, and oral and written communication.

The Associate in Applied Science degree will career ladder on the Certificate of Achievement by adding requirements in general education, computing, college level writing, and further internship experience, plus electives from electricity, electronics, carpentry, drafting, maintenance, welding, agriculture, automotive, computing, and other relevant technical areas.

The College plans to initiate the Sustainable Technology program full time on the campus and by the second year to rotate courses through cycles at the outreach sites of Molokai, Lanai, and Hana. By utilizing the college distance learning capability, the lecture-type courses will be presented over any one of several delivery systems including SkyBridge, cable, or Internet. The internship classes will be instructed "live" on site by either the lead teacher travelling out from campus or by a lecturer hired from that site. This cost-effective arrangement will reduce travel expenses, decrease personnel costs, and increase the SSHs from lecture classes by accommodating students from alternate sites into a single section.

The program has built in several features to maintain currency with industry. In addition to emphasis on theoretical foundations, students are required to intern at various government, business, or industry installations where presumably the most current technology is used.

Students already employed in the field could register for a portion of the program. Courses could easily be offered on a non-credit, pay-as-you-go basis. There are no admission requirements to the program. Minimum levels of English and math are required for entry into the initial ENRGY 101 course, which is a pre- or co-requisite for other ENRGY courses. (See Appendix A.)

Discussions with Maui County high schools will proceed toward Tech Prep and school-to-work agreements. Courses will be articulated allowing high schools to prepare students for the program.

While the program has been designed for job preparation, care has been taken to keep the content at a level that would allow for establishing an Associate in Science option that could be transferred as

described in CCCM #6100. A student must have the reading, writing, and analytical skills to be successful in any freshman transfer course. There have been preliminary discussions and a joint design project with the University of Hawaii at Manoa School of Architecture for collaboration, possible articulation, and team teaching of the program elements for transfer.

4. *Who will enroll in the program?*

Four categories of students are anticipated to use the curriculum and facilities of the program.

- Students who enroll full- or part-time to complete the entire program before employment.
- Students who enroll full- or part-time to complete the program before going for an advanced degree, who may either declare the program as a major or may declare themselves as liberal arts majors.
- Employed students who enroll to attain or improve particular skills.
- Non-major students will be encouraged to expand their technological literacy by enrolling in some of the core courses. Cross-major students from other career programs will be encouraged to enroll in ENRGY courses suitable to their major.

In the spring 1998 semester, the College first offered two Sustainable Technology courses approved through the College curriculum process on an experimental basis. The classes were added after the campus schedule of classes was printed, thereby limiting advertisement of the course availability. The subsequent fall term offered two courses at the outreach sites at Molokai, Lanai, and Hana, where an average class size of 14.7 students enrolled -- approaching the maximum class size of 15 students. The various courses so far have registered 265 students (see Appendix D), reflecting high student interest. Most recently the College placed an ad in the local press to start a cadre taking the experimental ENRGY courses in mid-spring 2001. More than 40 inquiries were received so far, with more than 30 indicating plans to enroll. Two other ads appearing soon will likely generate yet more students. A $10,300 Rebuild Hawaii grant will support intern activities and instructor travel to two Rebuild America conferences.

When the full Sustainable Technology program is approved, students will be recruited from Maui County high schools and from the local businesses that have indicated a need for training of their employees. Other students will be sought from under-represented minority and other groups expressing interest in technology employment.

5. *What resources are required for program implementation and first 5-year cycle operation?*

The funding needed for program development has been provided through several multi-year grants from the Department of Energy totaling $350,000+, with a $63,000+ grant from the Sohn Foundation, from sale of the first "eco-cottage" and from reallocation of lectureship resources within the College. The

major activities funded by the grants include a part-time project coordinator and lecturer, intern stipends, travel to outreach sites, technical training, a demonstration project, and special equipment needed for a Sustainable Technology program. The College reallocated from within its current budget to provide for additional instructional help for teaching and curriculum development.

To initiate the full cycle of programming in fall 2001, the College is awaiting approval to reallocate the vacant 1.0 Carpentry Technology position to initiate the sustainable energy portion of the program, or to employ lecturers. (See Appendix E.) The current 1.0 position in Building Maintenance will supplement instruction in energy classes as well as in electricity, internships, and electives. Extension of the Sustainable Technology program to outreach sites will use lectureship funds within the scope of the current budget. Growth of the program may require new allocations in the out-years. Current general education faculty, library, computer labs, learning resource center, and media center will provide the necessary academic support. The chart in Appendix F shows the projected funding to initiate programming in the first 5-year cycle.

6. *How efficient will the program be?*

The projected cost per student semester hour (SSH) ranges from $46 in fall 2001 to $28 in fall 2005, with the cost/SSH decreasing with enrollment expansion and extension to outreach sites.

	Fall 2001	*Fall 2002*	*Fall 2003*	*Fall 2004*	*Fall 2005*
Projected Cost/SSH	$46	$35	$30	$29	$28

Appendix G provides data on the projected average class size, FTE students, FTE student/faculty ratio, total SSH, and cost/SSH. Included are the assumptions upon which the projections are based and which account for the gradual decline to $28.

When compared to the cost per SSH of other MCC career programs, these costs rank favorably. Based on information from fall 2000, the cost per SSH for career programs at the College ranges from $22 per SSH for the business Careers program to $331 per SSH for the Agriculture program, with an average cost of $130 per SSH. Comparative cost per credit of other career programs at Maui Community College is shown in Appendix H.

7. *How will effectiveness of the program be demonstrated?*

The total evaluation plan includes instructor and administrative evaluation of instruction, student evaluation of instruction, evaluation of completion rates, formal and informal cooperative education and internship performance evaluation, and employer evaluation of graduates of both the certificate and degree programs.

At the beginning of the final year of provisional status, the Dean of Instruction, the Sustainable Arts and Technology Unit Head, and the SUSTECH program coordinator will gather data to be used in the evaluation of the program. A community assessment to ascertain the continuing need for the program, a student and employer satisfaction survey, and a compiled analysis of the yearly program health indicators (Table 1) will serve as the basis for a recommendation to the University of Hawaii Senior Vice President and Chancellor for Community Colleges, the President of the University of Hawaii, and the Board of Regents regarding continuation of the program. The recommendation will be submitted through the normal curriculum review channels. Internally, the Dean of Instruction with the Unit Head for Sustainable Arts and Technology, and the SUSTECH faculty will follow established procedures for judging the viability of this new program.

Table 1

Program Health Indicators

To be used to evaluate yearly

Program Demand/ Centrality	***Minimum***	***Satisfactory***
Number of student majors	45	60
Number of classes taught per year	10	11
Number of classes wait-listed/over enrolled	0	1
Program Efficiency		
Class size average	14	14
Class fit	93%	95%
Number of small classes (n<10 students)	0	0
Percent of sections taught by lecturers	15%	25%
Number of Advisory Committee meetings per academic year	2	3
Program equipment: percent inadequate items (as judged by Advisory Committee) replaced or upgraded	85%	95%
Program Outcomes		
Student evaluations: percent high ranks	85%	95%
Course completion rate	80%	85%
Program completion rate	70%	80%
Percent graduates employed in related field, or continuing education	85%	90%
Program judged adequate or better by:		
Employers of graduates	85%	95%
Employers of in-service trainees	85%	95%
Employers of interns or cooperative education students	85%	95%

Appendix A

Program Description

Program Prerequisites

The following minimum competencies will be required of students entering the SUSTECH program:

- reading and writing placement at English 55 or higher.
- mathematics placement at Mathematics 22 or higher.

Program Goals and Exit Competencies

The SUSTECH program is designed to provide students with the skills and competencies to provide entry and intermediate level employment skills as well as in-service training for the highly technical fields of installation, service, and repair of structures and equipment utilized in alternative energy technology.

Core Competencies

A core of courses will provide students with core competencies. Students will:

- Learn fundamental concepts of alternative energy and sustainability.
- Learn fundamental concepts of electronic and computer technology.
- Apply mathematics concepts and formulas for application to the alternative energy technologies .
- Identify and describe the basic properties and units of electricity.
- Analyze and measure circuits.
- Use operating systems on various computers to create files, perform systems functions, establish common procedures, manipulate queues, sort files, list files, edit files, and compile programs.
- Learn fundamental concepts of building structures.
- Develop basic skills in the design, installation, and maintenance of sustainable energy systems.
- Learn fundamental concepts of hazardous materials detection and abatement.
- Use laboratory testing/operating systems required for the appropriate treatment of wastewater.

Certificates of Competence Requirements: 7 credits each

Energy Management (7):

ENRGY 101 Intro to Sustainable Technology (3)
ENRGY 102 Energy Management Systems (3)
ENRGY 193V Internship (1)

Energy Production (7):

ENRGY 101 Intro to Sustainable Technology (3)
ENRGY 103 Energy Production Systems (3)
ENRGY 193V Internship (1)

Energy Control (7):

ENRGY 101 Intro to Sustainable Technology (3)
ENRGY 104 Energy Storage & Control Systems (3)
ENRGY 193V Internship (1)

Biomass Processes (7):

ENRGY 101 Intro to Sustainable Technology (3)
ENRGY 105 Biomass Energy Processes (3)
ENRGY 193v Internship (1)

Certificate of Achievement Requirements: 33 credits

Existing Courses: 14 credits

3 credits	ELEC 20 Introduction to Electricity
1 credit	OSH 20 Intro to Occupational Safety & Health
1 credit	HLTH 31 First Aid & Safety
3 credits	MATH 23 Practical Algebra
3 credits	ENG 55 Written Communications or ENG 100 Expository Writing
3 credits	Oral Communications: SP 151 or BUS/COMUN 130

New Courses: 19 credits

3 credits	ENRGY 101 Intro to Sustainable Technology
3 credits	ENRGY 102 Energy Management Systems
3 credits	ENRGY 103 Energy Production Systems
3 credits	ENRGY 104 Energy Storage and Control Systems
3 credits	ENRGY 105 Biomass Energy Processes
4 credits	ENRGY 193v Intern Activity with Practical Experience

Associate in Applied Science Requirements: 65 credits

General Education Requirements: 19 credits

*	3 credits	MATH 23 Practical Algebra
*	3 credits	ENG 55 Business Communications-Written or ENG 100 Expository Writing
*	3 credits	Oral Communications: SP 151 or BUS/COMUN 130
	4 credits	SCI 122 Physical Science
	3 credits	Social Science elective
	3 credits	Humanities elective

Core Requirements Existing Courses: 24 credits

*	3 credits	ELEC 20 Introduction to Electricity
*	1 credit	OSH 20 Intro to Occupational Safety & Health
*	1 credit	HLTH 31 First Aid & Safety
	3 credits	ICS 100 Computing Literacy, or DP 101 Data Processing
	3 credits	PHYS 50 Technical Physics
	3 credits	ENG 100 Expository Writing or ENG 209 Business & Management Writing
	9 credits	ELEC, ETRON, ICS, CARP, MAINT, WELD, AG, or AMT, w/consent

New Courses: 23 credits

*	3 credits	ENRGY 101 Intro to Sustainable Technology
*	3 credits	ENRGY 102 Energy Management Systems
*	3 credits	ENRGY 103 Energy Production Systems
*	3 credits	ENRGY 104 Energy Storage and Control Systems
*	3 credits	ENRGY 105 Biomass Processes
*	8 credits	ENRGY 193v Intern Activity with Practical Experience

*Note — Courses required for the Certificate of Achievement.

Sustainable Technology Program Plan

Requirements for Certificates of Competence:

Energy Management: (7)
Energy 101 (3), 102 (3), 193V (1)

Energy Production: (7)
Energy 101 (3), 103 (3), 193v (1)

Energy Control: (7)
Energy 101 (3), 104 (3), 193V (1)

Biomass Processes: (7)
Energy 101 (3), 105 (3), 193v (1)

Requirements for Certificate of Achievement: 33 credits

Energy 101 (3), 102 (3), 103 (3), 104 (3), 105 (3), 193V (4)
Electricity 20 (3)
Health 31 (1)
English 55 or English 100 (3)
SP 151 or Business Communication 130
Mathematics 23 (3)
Occupational Safety & Health 20 (1)

Requirements for Associate in Applied Science: 65 credits

All Certificate of Achievement courses plus:
Energy 193V (8)
Physics 50 (3)
Science 122 (4)
ICS 100 or DP 101 (3)
English 100 or English 209 (3)
Humanities elective (3)
Social Science elective (3)
Technical electives (9) with consent:
ELEC, ETRON, CARP, MAINT, DRAFT, WELD, ICS, AG, or AMT

A full-time student would take courses in this sequence:

First Semester (Fall)	**Credits**
*ENRGY 101 Intro to Sustainable Technology	3
*ENRGY 103 Energy Production Systems	3
*ELEC 20 Intro to Electricity	3
*MATH 23 Practical Algebra	3
*OSH 20 Intro to Occupational Safety & Health	1
*HLTH 31 First Aid & Safety	1
*ENRGY 193v Internship	2
	16

Second Semester (Spring)	**Credits**
*ENRGY 102 Energy Management Systems	3
*ENRGY 104 Energy Storage Control	3
*ENRGY 105 Biomass Processes	3
*BUS/COMUN 130 Bus Communication--Oral	3
or SP 151 Personal & Public Speaking	3
*ENG 55 Business Communications-Written	3
or ENG 100 Expository Writing **	
*ENRGY 193v Internship	2
	17

Third Semester (Fall)	**Credits**
DP 101 Data Process or ICS 100 Computer Lit	3
PHY 50 Technical Physics	3
Social Science elective	3
ENRGY 193v Internship	2
Electives: ELEC, ETRON, MAINT, CARP DRAFT, WELD, ICS, AG, AMT	5
	16

Fourth Semester (Spring)	**Credits**
SCI 122 Intro to Science: Physical Science	4
ENG 100 Expository Writing or	
ENG 209 Business & Mgt Writing **	3
Humanities elective	3
ENRGY 193v Internship	2
Electives: ELEC, ETRON, MAINT, CARP, DRAFT, WELD, ICS, AG, AMT	4
	16

* *Courses required for the Certificate of Achievement..*
** *ENG 55 is a prerequisite for ENG 100; ENG 100 is a prerequisite for ENG 209. It is preferred that the students take ENG 100 and either ENG 55 or ENG 209.*

MAUI COMMUNITY COLLEGE

COURSE OUTLINE

1.	COURSE TITLE:	ENRGY 101 Introduction to Sustainable Technology
	NUMBER OF CREDITS:	Three (3)
	ABBREVIATED COURSE TITLE:	Intro Sust Tech
	DATE OF OUTLINE:	October 10, 1999
2.	COURSE DESCRIPTION:	Introduces alternative methods for meeting long term energy needs, identifies and explores local resources including demand-side management of conventional gas and electric power and sustainable energy resources (such as solar, wind, biomass, small hydroelectricity, geothermal, ocean thermal energy conversion and alternative transportation fuel options.)
3.	CONTACT HOURS PER WEEK:	Lecture - Three (3)
4.	PREREQUISITES:	Placement at ENG 22 or 55; and placement at MATH 22 or higher, or consent.
	CO-REQUISITES:	None
	RECOMMENDED PREPARATION:	ICS 100 or DP 101 and placement at ENG 100.

APPROVED BY _____ DATE_____

5. COURSE OBJECTIVES:
   a. To introduce state-of-the-art resources in the emerging field of energy production/management.
   b. To identify and explore the mix of resources available on Maui and in the State of Hawaii.
   c. To experiment with existing sustainable projects on campus and in the community.
   d. To participate in publicizing sustainable solutions on campus and in the community

6. SPECIFIC COURSE OBJECTIVES: Upon completion of this course, the student should be able to:
   a. Identify and apply safety rules associated with design, construction and installation of sustainable energy systems.
   b. Explore energy management systems (EMS), lighting systems, air conditioning systems, timers, and controls.
   c. Operate on-line monitoring of campus electrical meters, graphing, footprinting and report writing.
   d. Conduct pre and post-retrofit testing of lighting circuits, calculations of energy savings and implications for reduction in electric bill.
   e. Explore solar thermal applications, heating water, drying/cooking food products, running air conditioning systems, and distilling water.
   f. Explore solar thermal/photovoltaic project utilizing EcoCottage and campus demonstration project building plans and site.
   g. Explore wind and micro hydroelectric systems project utilizing EcoCottage and existing Maui County installations.
   h. Explore biomass systems, composting, agriculture wastes, ocean plants, feed stock, landfill implications, chemical processes, and anaerobic digestion systems.
   i. Explore hybrid systems, battery technology, low voltage control systems, inverters and generators, alternative transportation fuels, geothermal, and ocean thermal applications.
   j. Prepare an Integrated Resource Plan (IRP), combining all systems into a written plan to be used as input to PUC approved IRP committee.

7. Recommended Course Content:

1-3 Weeks:	General Power Distribution Systems
1-3 Weeks:	Energy management system familiarization, design, and operation
1-3 Weeks:	Solar powered energy systems, design, and construction methods.
1-3 Weeks:	Hybrid powered energy systems, design and construction methods.
1-3 Weeks:	Biomass energy/digestion systems, design, and operation.
1-3 Weeks:	Energy storage, low voltage control systems, inverters, and generators
1-3 Weeks:	Integrated Resource Planning, combining all systems into a written plan for input to PUC approved IRP committee.

8. RECOMMENDED COURSE REQUIREMENTS: Specific course requirements are at the discretion of the instructor at the time the course is being offered. Suggested requirements might include, but are not limited to:

Written and oral examinations
In-class exercises
Homework assignments
Quizzes
Projects and research (written reports and/or oral class presentations,
Attendance and class participation

9. TEXT AND MATERIALS: Appropriate text(s) and materials will be chosen at the time the course is to be offered from those then currently available in the field. Examples include:

Texts:
Hazen, Mark E., Alternative Energy, An Introduction to Renewable Energy Sources, 1st Edition.

Berger, John J., Charging Ahead, The Business of Renewable Energy.

Materials:
Proprietary Workbook Practice Sets
Articles and/or handouts prepared by the instructor
Magazine or newspaper articles

Other:
Appropriate films, videos and internet sites
Television programs
Guest speakers
Other instructional aids

10. EVALUATION AND GRADING:

Quizzes, midterm, and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

11. Methods of Instruction: Instructional methods vary considerably with instructors, and specific instructional methods will be at the discretion of the instructor teaching the course. Suggested techniques might include, but are not limited to:

Lecture, problem solving and class exercises
Class discussions and guest lecturers
Audio, visual and internet presentations
Student class presentations
Group and individual projects
Other techniques (Service Learning, Co-op, Self-paced, etc)

ENERGY 101
Introduction to Sustainable Technology
FALL 2000

Instructor:	Don Ainsworth	Office Hours: Tue and Wed
Office:	2207 Room 11	3:00 - 4:30 pm
Phone:	984-3384	Other times by appointment

Text and Materials: Texts: Hazen Mark E., Alternative Energy, An Introduction to Renewable Energy Sources, 1st Edition.

Materials: Course workbook available at the campus bookstore.

Course Description: Introduces alternative methods for meeting long term energy needs, identifies and explores local resources including demand-side management of conventional gas and electric power and sustainable energy resources (such as solar, wind, biomass, small hydroelectricity, geothermal, ocean thermal energy conversion and alternative transportation fuel options.) **Contact Hours per Week: 3**

Prerequisite: Placement at ENG 55 and MATH 22, or higher or consent.

Course Content: We will be covering alternative methods for meeting long term energy needs. We will cover selected chapters of the text and will complete the course workbook, with a quiz after each of the workbook units. See attached schedule of classes for details.

Course Competencies: Upon satisfactory completion of this course, you should be able to:

1. Identify and apply safety rules associated with design, construction and installation of sustainable energy systems.
2. Explain energy management systems (EMS), lighting systems, HVAC systems, timers and controls.
3. Operate PCMAP software for on-line monitoring of campus meters, graphing, trend identification and report writing.
4. Conduct pre and post-retrofit testing of lighting circuits, calculations of energy savings and implications for reduction in electric bill.
5. Explain solar thermal applications, heating water, drying and cooking food products, running air conditioning systems and distilling water.
6. Identify components of Solar Thermal/Photovoltaic project utilizing demonstration project(s) on campus and in the community.
7. Describe Wind and Micro Hydroelectric systems project utilizing EcoCottage and existing Maui County installations.
8. Explain biomass systems, composting, agriculture wastes, ocean plants, feed stock, landfill implications, chemical processes and anaerobic digestion systems such as the STI plant in Kula
9. Explain hybrid systems, battery technology, low voltage control systems, inverters and generators, and alternative transportation fuels, geothermal and ocean thermal applications.
10. Prepare an Integrated Resource Plan (IRP), combining all systems into a written plan to be used as input to PUC approved IRP committee.

Homework and Attendance: Assigned homework must be done before the next class period. Attendance at every class is essential for successful completion of the course requirements. If you miss a class or need help with assignments, please arrange to see me in my office. Please call to set an appointment, or stop by during office hours.

Grades: Grading will be determined by evaluating exam scores, design project(s), workbook sets and class participation. Grade distribution will be as follows:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

Make-up Exams: Please do not miss a scheduled exam. If you are unable to attend any exam session, you must notify me before the exam is given so that we can schedule a make-up exam.

SCHEDULE OF CLASSES

Energy 101 – Fall 2000

Unit 1- 3 hours:	Introduction, Generation & Distribution Systems
Unit 2- 6 hours:	Energy Management Systems, Design & Operation
Unit 3- 6 hours:	Solar Energy Systems, Design & Construction
Unit 4- 6 hours:	Hybrid Energy Systems, Design & Construction
Unit 5- 3 hours:	MID-TERM EXAM
Unit 6- 6 hours:	Biomass Energy Processes, Design and Operation
Unit 7- 6 hours:	Energy Storage Systems
Unit 8- 6 hours:	Energy Control Systems
Unit 9 - 3 hours:	Integrated Resource Planning :
Unit 10 - 3 hours:	FINAL EXAM

MAUI COMMUNITY COLLEGE

COURSE OUTLINE

1. COURSE TITLE: ENRGY 102 Energy Management Systems

   NUMBER OF CREDITS: Three (3)

   ABBREVIATED COURSE TITLE: ENRGY Mgt Sys

   DATE OF OUTLINE: October 10, 1999

2. COURSE DESCRIPTION: Introduces methods for meeting long term energy conservation, identifies and explores alternative monitoring and control systems and local energy efficient devices, including demand-side management of conventional gas and electric power as well analysis of available new and retrofitted energy systems and their place in the integrated resource planning program in Maui County.

3. CONTACT HOURS PER WEEK: Lecture - Three (3)

4. PREREQUISITES: ENRGY 101 or concurrent enrollment, or consent

   CO-REQUISITES: None

   RECOMMENDED PREPARATION: None

APPROVED BY _____ DATE_____

5. COURSE OBJECTIVES:
   a. To introduce state-of-the-art systems in energy conservation
   b. To operate low voltage lighting, timers and control systems to optimize energy conservation.
   c. To gather data, identify solutions to energy conservation and prepare proposals for system improvements.
   d. To modify high voltage energy system components and operating schedules to qualify for rebates and special rate schedules from power company.
   e. To experiment with existing conservation projects on campus and in the community. To participate in publicizing energy conservation on campus and in the community.

6. SPECIFIC COURSE OBJECTIVES: Upon completion of this course, the student should be able to:
   a. Identify and apply safety rules associated with energy conservation systems.
   b. Operate energy management systems, lighting systems, HVAC systems, timers and controls.
   c. Operate software for on-line monitoring of campus meters, graphing, foot-printing and report writing.
   d. Conduct pre and post-retrofit testing of lighting circuits, calculations of energy savings and implications for reduction in electric bill.
   e. Prepare a campus area Energy Management Plan (EMP) to be used as input for controlling energy usage on campus.

7. Recommended Course Content:

0-1 Week:	Introduction, safety, syllabus, course requirements and general power distribution systems.
1-3 Weeks:	Power Generation, fossil fuels biomass and sustainable energy sources
1-3 Weeks:	Power Distribution, transmission-high voltage, step-up and step-down transformers, distribution - low voltage, metering and the PUC
1-3 Weeks:	Energy Audits, high voltage power circuits, low voltage power circuits, and lighting circuits
1-3 Weeks:	Retro-fit Energy Conservation Design, motors and HVAC systems, interior lighting and temperature controls, exterior lighting and zoning
1-3 Weeks:	Develop an energy management plan for approval by Maui Community College Director of Administrative Services, collect data, calculate savings, submit to MECO for rebates
1-3 Weeks:	Access MCC's main meters through modem, monitor power consumption on-line, log anomalies, prepare reports recommending energy saving steps (supported by charts, graphs)
0-1 Week:	Submit final energy management report

8. RECOMMENDED COURSE REQUIREMENTS: Specific course requirements are at the discretion of the instructor at the time the course is being offered. Suggested requirements might include, but are not limited to:

Written and oral examinations
In-class exercises
Homework assignments
Quizzes
Projects and research (written reports and/or oral class presentations
Attendance and class participation

9. TEXT AND MATERIALS: Appropriate text(s) and materials will be chosen at the time the course is to be offered from those then currently available in the field. Examples include:

Texts: Turner, Energy Management Handbook.
Thumann, Handbook of Energy Audits.

Materials: Proprietary Workbook Practice Sets
Articles and/or handouts prepared by the instructor
Magazine or newspaper articles

Other: Appropriate films, videos and internet sites
Television programs
Guest speakers
Other instructional aids

10. EVALUATION AND GRADING:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

11. Methods of Instruction: Instructional methods vary considerably with instructors, and specific instructional methods will be at the discretion of the instructor teaching the course. Suggested techniques might include, but are not limited to:

Lecture, problem solving and class exercises
Class discussions and guest lecturers
Audio, visual and internet presentations
Student class presentations
Group and individual projects
Other techniques (Service Learning, Co-op, Self-paced, etc)

ENERGY 102
Energy Management Systems
FALL 2000

Instructor: Don Ainsworth
Office: 2207 Room 11
Phone: 984-3384

Office Hours: Tue and Wed
3:00 - 4:30 pm
Other times by appointment

Texts and Materials:
Text: Turner, Wayne C., Energy Management Handbook.
Materials: Course workbook available at the campus bookstore.

Course Description: Introduces methods for meeting long term energy conservation, identifies and explores alternative monitoring and control systems and local energy efficient devices, including demand-side management of conventional gas and electric power as well analysis of available new and retrofitted energy systems and their place in the integrated resource planning program in Maui County. **Contact Hours per Week: 3.**

Prerequisite: Credit or registration in ENRGY 101, or consent.

Course Content: We will be covering alternative methods for meeting long term energy conservation needs on Maui and in the State of Hawaii. We will cover all chapters of the text and will complete the course workbook, with a quiz after each of the workbook units. See attached schedule of classes for details.

Course Competencies: Upon satisfactory completion of this course, you should be able to:

1. To operate low voltage lighting, timers and control systems to optimize energy conservation.
2. To gather data, identify solutions to energy conservation and prepare proposals for system improvements.
3. To modify high voltage energy system components and operating schedules to qualify for rebates and special rate schedules from power company.
4. To experiment with existing conservation projects on campus and in the community.
5. To participate in publicizing energy conservation on campus and in the community.

Homework and Attendance: Assigned homework must be done before the next class period. Attendance at every class is essential for successful completion of the course requirements. If you miss a class or need help with assignments, please arrange to see me in my office. Please call to set an appointment, or stop by during office hours.

Grades: Grading will be determined by evaluating exam scores, design project(s), workbook sets and class participation. Grade distribution will be as follows:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

Make-up Exams: Please do not miss a scheduled exam. If you are unable to attend any exam session, you must notify me before the exam is given so that we can schedule a make-up exam.

SCHEDULE OF CLASSES

Energy 102 - Fall 2000

Unit 1- 3 hours	Introduction, safety, syllabus, course requirements and general power distribution systems.
Unit 2- 6 hours	Power Generation, fossil fuels biomass and sustainable energy sources
Unit 3- 6 hours	Power Distribution, transmission-high voltage, step-up and step-down transformers, distribution - low voltage, metering and the PUC
Unit 4- 6 hours	Energy Audits, high voltage power circuits, low voltage power circuits, and lighting circuits
Unit 5- 6 hours	Retro-fit Energy Conservation Design, motors and HVAC systems, interior lighting and temperature controls, exterior lighting and zoning
Unit 6- 3 hours	MID TERM EXAM
Unit 7- 6 hours	Energy management system on-line operation and control of MCC Campus lighting, air-conditioning and other power usage.
Unit 8- 6 hours	Develop an energy management plan for approval by Maui Community College Director of Administrative Services. Collect data, calculate savings, submit to Maui Electric Company for rebates
Unit 9- 6 hours	Access MCC's main meters through modem, monitor power consumption on-line, log anomalies, prepare reports recommending energy saving steps (supported by charts, graphs, etc.).
Unit 10- 3 hours	FINAL EXAM

MAUI COMMUNITY COLLEGE

COURSE OUTLINE

1.	COURSE TITLE:	ENRGY 103 Energy Production Systems
	NUMBER OF CREDITS:	Three (3)
	ABBREVIATED COURSE TITLE:	Energy Prod Sys
	DATE OF OUTLINE:	October 10, 1999
2.	COURSE DESCRIPTION:	Introduces theoretical concepts and practical applications of sustainable energy systems. Develops knowledge of photovoltaic, thermal, wind, hydro, ocean thermal, fossil, ocean wave, and absorption systems, with emphasis on solutions for residential and commercial applications in Hawaii.
3.	CONTACT HOURS PER WEEK:	Lecture - Three (3)
4.	PREREQUISITES:	ENRGY 101 or concurrent enrollment, or consent.
	CO-REQUISITES:	None
	RECOMMENDED PREPARATION:	None

APPROVED BY _____ DATE_____

5. COURSE OBJECTIVES:
   a. To introduce components and materials of sustainable energy systems.
   b. To identify and explore sustainable resources on Maui and in Hawaii.
   c. To experiment with sustainable energy projects on campus and in the community.
   d. To participate in developing sustainable resources on campus and on Maui.

6. SPECIFIC COURSE OBJECTIVES: Upon completion of this course, the student should be able to:
   a. Identify and apply safety rules related to design, construction and installation of sustainable energy systems.
   b. Examine, identify components, record data from, and operate existing sustainable energy systems.
   c. Calculate energy savings/efficiencies by use of standardized tables and observations for various sites on Maui.
   d. Conduct experiments using typical energy collection, storage, control, and utilization models.
   e. Explore current and emerging sustainable energy technology by library research and internet access.
   f. Explore sustainable energy system projects using the EcoCottage building plans and site.
   g. Review sustainable energy system applications for transportation and communications.
   h. Evaluate existing sustainable energy equipment on campus and in the community, and compare it to emerging sustainable energy equipment and technology.
   i. Review solar thermal and photovoltaic applications for emergency preparedness, disaster response, and recovery operations.
   j. Develop and prepare proposals for small-scale sustainable energy projects on the campus and in the community.

7. RECOMMENDED COURSE CONTENT:

0-1 Week:	Introduction, Safety, Overview
1-2 Weeks:	Review of Electrical Concepts and Designs
1-2 Weeks:	Sustainable Energy Concepts
1-2 Weeks:	Sizing a Sustainable Energy System Energy Modules and Applications
1-2 Weeks:	Regulators, System Voltage, Storage
1-2 Weeks:	DC Loads (direct) vs AC loads (inverters)
1-2 Weeks:	System Wiring, Testing, and Maintenance
1-2 Weeks:	Thermal Storage and Thermal Units (BTUs)
1-2 Weeks:	Applications and Typical Systems
1-2 Weeks:	System Siting and Performance
1 Week:	Future Developments

8. RECOMMENDED COURSE REQUIREMENTS: Specific course requirements are at the discretion of the instructor at the time the course is being offered. Suggested requirements might include, but are not limited to:

Written and oral examinations
In-class exercises
Homework assignments
Quizzes
Projects and research (written reports and/or oral class presentations
Attendance and class participation

9. TEXT AND MATERIALS: Appropriate text(s) and materials will be chosen at the time the course is to be offered from those then currently available in the field. Examples include:

Texts: St. John Andrew, Sourcebook for Sustainable Design.
Harvey, Micro-hydro Design Manual.
Gipe, Wind Power for Home and Business.

Materials: Proprietary Workbook Practice Sets
Articles and/or handouts prepared by the instructor
Magazine and newspaper articles

Other: Appropriate films, videos or internet sites
Television programs
Guest speakers
Other instructional aids

10. EVALUATION AND GRADING:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

11. Methods of Instruction: Instructional methods vary considerably with instructors, and specific instructional methods will be at the discretion of the instructor teaching the course. Suggested techniques might include, but are not limited to:

Lecture, problem solving and class exercises
Class discussions and guest lecturers
Audio, visual and internet presentations
Student class presentations
Group and individual projects
Other learning techniques (Service Learning, Co-op, Self-paced, etc)

ENERGY 103
Energy Production Systems
FALL 2000

Instructor: Don Ainsworth
Office: 2207 Room 11
Phone: 984-3384

Office Hours: Tue and Wed
3:00 - 4:30 pm
Other times by appointment

Text and Materials:
Text: St. John, Andrew. Sourcebook for Sustainable Design.
Materials: Course workbook available at the campus bookstore.

Course Description: Introduces theoretical concepts and practical applications of sustainable energy systems. Develops knowledge of photovoltaic, thermal, wind, hydro, ocean thermal, fossil, ocean wave and absorption systems, with emphasis on solutions for residential and commercial applications in Hawaii. **Contact Hours per Week: 3.**

Prerequisite: ENRGY 101 or concurrent enrollment, or consent.

Corequisite: None

Course Content: We will be covering components and materials of sustainable energy systems by identifying and exploring sustainable resources on Maui and in Hawaii. We will cover all chapters of the text and will complete the course workbook, with a quiz after each of the workbook units. See attached schedule of classes for details.

Course Competencies: Upon completion of this course, you should be able to:
1. Identify and apply safety rules related to the design, construction and installation of sustainable energy systems.
2. Identify components, record data from and operate existing sustainable energy systems.
3. Calculate energy savings/efficiencies by use of standardized tables and observations for various sites on Maui.
4. Conduct research on current and emerging sustainable energy technology using the library and internet resources.
5. Conduct experiments using typical energy collection, storage, control and utilization models.
6. Review sustainable applications for transportation and communication.
7. Evaluate existing sustainable energy systems on campus and in the community and compare them to emerging sustainable energy equipment and technology.
8. Develop and prepare proposals for small-scale sustainable energy projects on campus and in the community.

Homework and Attendance: Assigned homework must be done before the next class period. Attendance at every class is essential for successful completion of the course requirements. If you miss a class or need help with assignments, please arrange to see me in my office. Please call to set an appointment, or stop by during office hours.

Grades: Grading will be determined by evaluating exam scores, design project(s), workbook sets and class participation. Grade distribution will be as follows:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

Make-up Exams: Please do not miss a scheduled exam. If you are unable to attend any exam session, you must notify me before the exam is given so that we can schedule a make-up exam.

SCHEDULE OF CLASSES

Energy 103 - Fall 2000

Unit 1- 3 hours:	**Review of Electrical Concepts and Designs**
Unit 2- 3 hours:	**Types of Energy Systems**
Unit 3- 3 hours:	**Renewable Energy Concepts**
Unit 4- 3 hours:	**Sizing a Energy Systems**
Unit 5- 3 hours:	**Site Selection and Design**
Unit 6- 3 hours:	**Regulators, System Voltage, Storage**
Unit 7- 3 hours:	**DC Loads (direct) vs AC loads (inverters)**
Unit 8- 3 hours:	**System Wiring, Testing, and Maintenance**
Unit 9 - 3 hours:	**MID-TERM EXAM:**
Unit 10- 3 hours:	**Multi-Source Generation**
Unit 11- 3 hours:	**Thermal Storage & British Thermal Units** (BTUs)
Unit 12- 3 hours:	**Applications and Typical Systems**
Unit 12- 3 hours:	**System Siting and Performance**
Unit 13- 3 hours:	**Energy Transmission/Storage Medium**
Unit 14- 3 hours:	**Electrical Conversion Calculations**
Unit 15- 3 hours:	**The Future: Plasma Energy, Superconductivity, and Beyond**
Unit 16- 3 hours:	**FINAL EXAM**

MAUI COMMUNITY COLLEGE

COURSE OUTLINE

1.	COURSE TITLE:	ENRGY 104 Energy Storage and Control
	NUMBER OF CREDITS:	Three (3)
	ABBREVIATED COURSE TITLE:	ENRGY Stor Cntrl
	DATE OF OUTLINE:	October 10, 1999
2.	COURSE DESCRIPTION:	Introduces theoretical concepts and practical applications of energy storage and control systems. Develops knowledge of batteries, thermal energy storage, pumped hydro, flywheel technology, and phase change storage. Discusses control, monitoring, testing, and safety equipment for energy storage systems, with emphasis on solutions for residential and commercial applications in Hawaii.
3.	CONTACT HOURS PER WEEK:	Lecture - Three (3)
4.	PREREQUISITES:	ENRGY 101 or concurrent enrollment, or consent.
	CO-REQUISITES:	None
	RECOMMENDED PREPARATION:	None

APPROVED BY _____ DATE_____

5. COURSE OBJECTIVES:
   a. To introduce components and materials of energy storage and control systems.
   b. To identify and explore energy storage system resources on Maui and in Hawaii.
   c. To experiment with energy storage and control projects on campus and in the community.
   d. To participate in developing energy storage resources on campus and in Maui County.

6. SPECIFIC COURSE OBJECTIVES: Upon completion of this course, the student should be able to:

   a. Identify and apply safety rules related to design, construction and installation of energy storage and control systems.
   b. Examine, identify components, record data from, and operate existing energy storage systems.
   c. Calculate energy savings/efficiencies by use of standardized methodology and observations of energy storage systems for various sites on Maui.
   d. Design systems using typical energy storage, control, and utilization equipment.
   e. Explore current and emerging energy storage and control system technology by library research and internet access.
   f. Explore energy storage and control system projects using the EcoCottage and campus demonstration building plans and site.
   g. Review energy storage and control applications for transportation and communications.
   h. Evaluate existing energy storage equipment on campus and in the community, monitor the control systems, and compare them to emerging energy storage equipment and technology.
   i. Review energy storage and control systems for emergency preparedness, disaster response, and recovery operations.
   j. Develop and prepare proposals for small-scale energy storage and control projects on the campus and in the community.

7. RECOMMENDED COURSE CONTENT:

0-1 Week:	Introduction, Safety, Overview
1-2 Weeks:	Energy Storage Systems
1-2 Weeks:	Wiring and Control Systems
1-2 Weeks:	Instrumentation and Monitoring
1-2 Weeks:	Battery Reconditioning Charging, Discharging and Cycling of Batteries
1-2 Weeks:	Flywheel Energy Storage/Ice Storage/Rock
1-2 Weeks:	Thermal and Multi-source Energy Storage
1-2 Weeks:	Thermal and Hybrid Energy Controls
1-2 Weeks:	Thermal Conversions and Losses
1-2 Weeks:	Installed Cost vs Purchased Cost
1-2 Weeks:	Development of New Technology Energy Storage Devices

8. RECOMMENDED COURSE REQUIREMENTS: Specific course requirements are at the discretion of the instructor at the time the course is being offered. Suggested requirements might include, but are not limited to:

Written and oral examinations
In-class exercises
Homework assignments
Quizzes
Projects and research (written reports and/or oral class presentations
Attendance and class participation

9. TEXT AND MATERIALS: Appropriate text(s) and materials will be chosen at the time the course is to be offered from those then currently available in the field. Examples include:

Texts:
Siemens, Batteries and Charging Systems.
Garg, Advantages in Solar Energy Technology, Collection and Storage Systems.
Ter-Gazarian, Energy Storage for Power Systems.

Materials:
Proprietary Workbook Practice Sets
Articles and/or handouts prepared by the instructor
Magazine and newspaper articles

Other:
Appropriate films, videos or internet sites
Television programs
Guest speakers
Other instructional aids

10. EVALUATION AND GRADING:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

11. Methods of Instruction: Instructional methods vary considerably with instructors, and specific instructional methods will be at the discretion of the instructor teaching the course. Suggested techniques might include, but are not limited to:

Lecture, problem solving and class exercises
Class discussions and guest lecturers
Audio, visual and internet presentations
Student class presentations
Group and individual projects
Other learning techniques (Service Learning, Co-op, Self-paced, etc)

ENERGY 104
Energy Storage and Control
SPRING 2001

Instructor: Don Ainsworth
Office: 2207 Room 11
Phone: 984-3384

Office Hours: Tue and Wed
3:00 - 4:30 pm
Other times by appointment

Text and Materials:
Text: Ter-Gazarian, Energy Storage for Power Systems.
Materials: Course workbook available at campus bookstore.

Course Description: Introduces theoretical concepts and practical applications of energy storage and control systems. Develops knowledge of batteries, thermal energy storage, pumped hydro, flywheel technology, and phase change storage. Discusses control, monitoring, testing, and safety equipment for energy storage systems, with emphasis on solutions for residential and commercial applications in Hawaii. **Contact Hours per Week: 3.**

Prerequisite: ENRGY 101 or concurrent enrollment, or consent.

Corequisite: None

Course Content: We will be covering components and materials of sustainable energy systems by identifying and exploring sustainable resources on Maui and in Hawaii. We will cover all chapters of the text and will complete the course workbook, with a quiz after each of the workbook units. See attached schedule of classes for details.

Course Competencies: Upon completion of this course, you should be able to:
1. Identify and apply safety rules related to design and installation of energy storage and control systems.
2. Examine, identify components, record data from, and operate existing energy storage systems.
3. Calculate energy savings/efficiencies by use of standardized methodology and observations of energy storage systems for various sites on Maui.
4. Design systems using typical energy storage, control, and utilization equipment.
5. Explore current and emerging energy storage and control system technology by library research and internet access.
6. Explore energy storage and control system projects using campus demonstration building plans and site.
7. Review energy storage and control applications for transportation and communications.
8. Evaluate existing energy storage equipment on campus and in the community, monitor the control systems, and compare them to emerging energy storage equipment and technology.
9. Review energy storage and control systems for emergency preparedness, disaster response, and recovery operations.
10. Develop and prepare proposals for small-scale energy storage and control projects on the campus and in the community.

Homework and Attendance: Assigned homework must be done before the next class period. Attendance at every class is essential for successful completion of the course requirements. If you miss a class or need help with assignments, please arrange to see me in my office. Please call to set an appointment, or stop by during office hours.

Grades: Grading will be determined by evaluating exam scores, design project(s), workbook sets and class participation. Grade distribution will be as follows:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

Make-up Exams: Please do not miss a scheduled exam. If you are unable to attend any exam session, you must notify me before the exam is given so that we can schedule a make-up exam.

SCHEDULE OF CLASSES

Energy 104 - Spring 2001

Unit 1- 3 hours:	**Introduction, Safety, Overview**
Unit 2- 3 hours:	**Energy Storage Systems**
Unit 3- 3 hours:	**Battery Systems and Safety**
Unit 4- 3 hours:	**Wiring and Control Systems**
Unit 5- 3 hours:	**Instrumentation and Monitoring**
Unit 6- 3 hours:	**Battery Reconditioning**
Unit 7- 3 hours:	**Charging/Discharging/Cycling of Batteries**
Unit 8- 3 hours:	**Flywheel Energy Storage/Ice Storage/Rock Storage**
Unit 9 - 3 hours:	**MID-TERM EXAM**
Unit 10- 3 hours:	**Thermal Energy Storage**
Unit 11- 3 hours:	**Multi-Source Energy Storage**
Unit 12- 3 hours:	**Thermal and Hybrid Energy Controls**
Unit 13- 3 hours:	**Thermal Conversions and Losses**
Unit 14- 3 hours:	**Installed Cost vs Purchased Cost**
Unit 15- 3 hours:	**Development of New Technology Energy Storage Devices**
Unit 16- 3 hours:	**FINAL EXAM**

MAUI COMMUNITY COLLEGE

COURSE OUTLINE

1.	COURSE TITLE:	ENRGY 105 Biomass Energy Processes
	NUMBER OF CREDITS:	Three (3)
	ABBREVIATED COURSE TITLE:	Bio Process
	DATE OF OUTLINE:	October 10, 1999
2.	COURSE DESCRIPTION:	Introduces theoretical concepts and practical applications of methods for meeting long term energy needs on Maui and in the State of Hawaii through the utilization of biomass to produce energy and environmentally friendly by-products.
3.	CONTACT HOURS PER WEEK:	Lecture - Three (3)
4.	PREREQUISITES:	ENRGY 101 or concurrent enrollment, or consent
	CO-REQUISITES:	None
	RECOMMENDED PREPARATION:	None

APPROVED BY _____ DATE_____

5. COURSE OBJECTIVES:
   1. To introduce state-of-the-art resources in the emerging field of biomass energy production.
   2. To identify and explore the mix of biomass energy resources available on Maui and in the State of Hawaii.
   3. To participate in biomass and/or bioconversion projects in Maui County.

6. SPECIFIC COURSE OBJECTIVES: Upon completion of this course, the student should be able to:

   a. Identify and apply safety rules related to design, construction, and installation of biomass energy systems.
   b. Examine, identify components, record data from and recognize existing biomass energy systems.
   c. Calculate energy savings and efficiencies by use of standardized tables and observations for various sites on Maui.
   d. Conduct experiments using typical biomass production, refining, and use models.
   e. Explore current and emerging biomass technology through library research and internet access.
   f. Explore biomass using local biofuel processor data and production records.
   g. Review biomass applications for transportation and communication systems.
   h. Evaluate existing biomass applications for utilization of idle land, reduction of pollution, increase in local employment, and keeping Maui green.
   i. Evaluate existing potential on campus and in the community, and compare it to emerging biomass equipment and technology.
   j. Develop and prepare proposals for small-scale biomass energy projects on campus and in the community.

7. RECOMMENDED COURSE CONTENT:

0-1 Week:	Introduction, safety, course requirements, biomass systems overview.
1-3 Weeks:	Agricultural dilemmas, and pressures, producing biomass and using biomass as fuel.
1-3 Weeks:	Electricity from biomass, gas turbines and gasification.
1-3 Weeks:	Biomass integrated power stations and generating technology.
1-3 Weeks:	Development strategies and economic overview.
1-3 Weeks:	Emerging markets; when, where & how.
1-3 Weeks:	Assessing potential for energy autonomy for an island community.
0-1 Week:	Submit final biomass research report.

9. RECOMMENDED COURSE REQUIREMENTS: Specific course requirements are at the discretion of the instructor at the time the course is being offered. Suggested requirements might include, but are not limited to:

Written and oral examinations
In-class exercises
Homework assignments
Quizzes
Projects and research (written reports and/or oral class presentations
Attendance and class participation

9. TEXT AND MATERIALS: Appropriate text(s) and materials will be chosen at the time the course is to be offered from those then currently available in the field. Examples include:

Texts:
Patterson, Power From Plants.
Spellman, Wastewater Biosolids to Compost.

Materials:
Proprietary Workbook Practice Sets
Articles and/or handouts prepared by the instructor
Magazine or newspaper articles

Other:
Appropriate films, videos or internet sites
Television programs
Guest speakers
Other instructional aids

10. EVALUATION AND GRADING:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

11. Methods of Instruction:
Instructional methods vary considerably with instructors, and specific instructional methods will be at the discretion of the instructor teaching the course. Suggested techniques might include, but are not limited to:

Lecture, problem solving and class exercises
Class discussions and guest lecturers
Audio, visual and internet presentations
Student class presentations
Group and individual projects
Other techniques (Service Learning, Co-op, Self-paced, etc)

ENERGY 105
Biomass Energy Processes
Spring 20001

Instructor: Don Ainsworth
Office: 2207 Room 11
Phone: 984-3384

Office Hours: Tue and Wed
3:00 - 4:30 pm
Other times by appointment

Text and Materials:
Patterson, Power From Plants. Course workbook available from campus bookstore.

Course Description: Introduces theoretical concepts and practical applications of methods for meeting long term energy needs on Maui and in the State of Hawaii through the utilization of biomass to produce energy and environmentally friendly by-products. **Contact Hours per Week: 3.**

Prerequisite: ENRGY 101 or concurrent enrollment, or consent.

Corequisite: None

Course Content: We will be covering components and materials of sustainable energy systems by identifying and exploring sustainable resources on Maui and in Hawaii. We will cover all chapters of the text and will complete the course workbook, with a quiz after each of the workbook units. See attached schedule of classes for details.

Course Competencies: Upon completion of this course, you should be able to:

1. Identify and apply safety rules related to design, construction and installation of biomass energy systems.
2. Examine, identify components, record data from and recognize existing biomass energy systems.
3. Calculate energy savings and efficiencies by use of standardized tables and observations for various sites on Maui.
4. Conduct experiments using typical biomass production, refining and use models.
5. Explore current and emerging biomass technology through library research and internet access.
6. Explore biomass using local biofuel processor data and production records.
7. Review biomass applications for transportation and communication systems.
8. Evaluate existing biomass applications for utilization of idle land, reduction of pollution, increase in locate employment and keeping Maui green.
9. Evaluate existing potential on campus and in the community, and compare it to emerging biomass equipment and technology.
10. Develop and prepare proposals for small-scale biomass energy projects on campus and in the community.

Homework and Attendance: Assigned homework must be done before the next class period. Attendance at every class is essential for successful completion of the course requirements. If you miss a class or need help with assignments, please arrange to see me in my office. Please call to set an appointment, or stop by during office hours.

Grades: Grading will be determined by evaluating exam scores, design project(s), workbook sets and class participation. Grade distribution will be as follows:

Quizzes, midterm and final exams	10-50%
Design projects and workbook sets	10-50%
Attendance and/or class participation	20%

Make-up Exams: Please do not miss a scheduled exam. If you are unable to attend any exam session, you must notify me before the exam is given so that we can schedule a make-up exam.

SCHEDULE OF CLASSES

Energy 105 - Spring 2001

Unit 1- 3 hours	Introduction, safety, course requirements, biomass systems overview.
Unit 2- 6 hours	Agricultural dilemmas, and pressures.
Unit 3- 6 hours	Producing biomass and using biomass as fuel.
Unit 4- 6 hours	Electricity from biomass, gas turbines and gasification.
Unit 5- 3 hours	MID-TERM EXAM
Unit 6- 6 hours	Biomass integrated power stations and generating technology.
Unit 7- 6 hours	Development strategies and economic overview.
Unit 8- 6 hours	Emerging markets; when, where & how.
Unit 9- 6 hours	Assessing potential for energy autonomy for an island community.
Unit 10- 3 hours	Present final biomass research report.

MAUI COMMUNITY COLLEGE

COURSE OUTLINE

1.	COURSE TITLE:	NRGY 193V Internship In Sustainable Technology
	NUMBER OF CREDITS:	One-Eight (1-4)
	ABBREVIATED COURSE TITLE:	Internship
	DATE OF OUTLINE:	October 10, 1999
2.	COURSE DESCRIPTION:	Introduces the student to the workplace on a job within the student's area of interest and preparation. The student and instructor will jointly develop learning objectives, and evaluation will be jointly performed by the instructor and the employment supervisor. Can be repeated for a maximum of eight (8) credits.
3.	CONTACT HOURS PER WEEK:	75 hours of supervised work per credit
4.	PREREQUISITES:	Credit or enrollment in NRGY 101, 102,103, 104, or 105, and consent.
	CO-REQUISITES:	None
	RECOMMENDED PREPARATION:	ENG 100 and ICS 100 or DP 101, or equivalent.

APPROVED BY _____ DATE_____

5. COURSE OBJECTIVES: To introduce the student to the workplace on a job within the student's area of interest and preparation. The student and instructor will jointly develop learning objectives, and evaluation will be jointly performed by the instructor and the employment supervisor.

6. SPECIFIC COURSE OBJECTIVES: Upon completion of this course, the student should be able to:

a. Demonstrate the responsibilities required of a job position including exhibiting dependability and meeting organizationally defined expectations.
b. Follow rules, regulations and policies as established in employee/employer handbook.
c. Practice time management and follow work schedules.
d. Display initiative and seek work challenges.
e. Understand and apply ethical principles to decision making.
f. Understand the importance of providing good customer service.
g. Respond constructively to suggestions for improvement.
h. Recognize problems and work toward their solution.
i. Demonstrate understanding of interactive relationships required for effective teamwork.
j. Adapt as necessary to complete the team task.

Appendix B

Labor Department Employment Outlook

Maui County

Occupation Titles in Sustainable Tech	*1996*	*2006*	*Openg*	*Growth*	*Separ*	*Annl*
Carpenters	330	360	100	40	60	10
Construction, Building Inspectors	70	80	30	10	20	*
Drafters	80	90	20	0	20	*
Electricians	200	270	110	70	40	10
First Line Superv: Const, Extrac	200	240	80	40	40	10
Maintenance Repairers, Gen'l Util	1240	1700	710	460	250	70
Plumbers, Pipefitters, Steamfitters	120	160	70	40	30	10
Roofers	20	30	20	10	10	*
Maui County Overall SUSTECH	*2260*	*2930*	*1140*	*670*	*470*	*110*

Note.— Extracted from State of Hawaii Employment Outlook for Industries and Occupation, Maui County, 1996-2006, Dept. of Labor & Industrial Relations, Feb 2000.

Statewide

Occupation Titles in Sustainable Tech	*1998*	*2008*	*Number*	*Percent*	*Growth*	*Separ*	*Total*
Capenters/Related Helpers	590	760	170	28.8	20	30	50
Carpenters	3,850	4,670	820	21.3	80	100	180
Construction Trades Helpers	80	100	20	25	*	*	*
Construction Trades Workers	1,130	1,370	240	21.2	20	30	50
Construction Trades Workers	4,080	4,950	870	21.3	90	110	200
Construction, Bldg Inspectors	630	710	80	12.7	10	20	30
Consturction Trades Helpers	1,200	1,480	280	23.3	30	60	90
Drafters	960	1,080	120	12.5	10	20	30
Electrical Workers	1,850	2,150	300	16.2	30	40	70
Electricians	1,850	2,150	300	16.2	30	40	70
Electrician, Related Helpers	70	70	0	0	*	*	*
First Line Supervs: Constn, Extrac	1,340	1,720	380	28.4	40	40	80
Maintenance Repairers, Gen'l Util	6,540	7,220	680	10.4	70	150	220
Plant and System Operators	240	270	30	12.5	*	10	10
Plumbers and Related Workers	1,580	1,750	170	10.8	20	20	40
Plumber, Related Helpers	150	170	20	13.3	*	*	*
Roofers	320	370	50	15.6	10	10	20
Roofer Helpers	90	100	10	11.1	*	*	*
State Totals	*26,550*	*31,090*	*4,540*	*16.8*	*460*	*680*	*1,140*

Note.— Extracted from State of Hawaii Employment Outlook for Industries and Occupation, 1998-2008, Dept. of Labor & Industrial Relations, October 2000.

Appendix C

Community Needs Assessment

NEEDS ASSESSMENT FOR EDUCATION IN SUSTAINABLE TECHNOLOGIES ON MAUI

Maui Community College
Spring 1997

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NEEDS ASSESSMENT FOR EDUCATION IN SUSTAINABLE TECHNOLOGIES ON MAUI

Maui Community College
Spring 1997

PURPOSE

The purpose of this survey was to ascertain the potential demand for pre-service and in-service training in Sustainable Technologies over the next five years from related businesses on Maui. The primary research question is whether the extent of employment demand justifies the development and initiation of a certificate or degree program in Maui Community College Sustainable Technologies (MIST). A secondary objective is to evaluate several programming aspects including content and time for classes.

METHODOLOGY

In the Spring 1997 semester the Survey Development Team (Appendix A) including the MIST Advisory Committee, MIST Coordinator, Director of Rural Community Leadership Program, and the Assistant Dean of Instruction, under auspices of the Dean of Instruction, developed and fieldtested a needs assessment questionnaire (Appendix B).

In April 1997, the questionnaire was mailed to 80 businesses randomly selected from relevant categories of the yellow pages of the 1996-97 Maui telephone directory. The initial return of 27 respondents was too small to draw reliable conclusions. A second mailing list was extracted from the yellow pages, using all businesses in the relevant categories. The list cut across a broad spectrum of businesses, including building, electrical, and plumbing contractors, architects, waste disposal, power generators, agriculture, automotive repairers, and hotels. The sampling strategy was to poll the full population of potential Maui businesses which might in the next five years hire employees with Sustainable Technologies skill, to gain a complete picture of the potential community demand from all relevant employment sectors.

The number of respondents was 54 overall. This represents a return rate of 12.2 percent (500 mailouts less 57 returned for insufficient address = 443 sample size). (Note: All 443 recipients would not be expected to reply because the inclusive sampling strategy, by its nature, includes many for whom the survey does not apply.)

RESULTS

A. Employment Demand

The survey item dealing with potential employment demand from the community for persons with SusTech skill asked, "In the next five years, how many staff with Sustainable Technologies skill do you expect to hire?" Results to this item are displayed in Table 1 and discussed below.

Table 1
Anticipated Demand for SusTech Employees

Sector (No.)	Exp'd Hires	Expansion	Replacement	Firms Hiring
Building (7)	3	0	3	2
Electrical (12)	36	17	19	8
Plumbing (6)	22	16	6	6
Architects (4)	4	2	2	2
Power (3)	3	2	1	1
Hotels (11)	25	0	25	7
Auto (3)	6	2	4	2
Misc (8)	15	14	1	6
Total (54)	**114**	**53**	**61**	**34**

Number of Hires. Applicants with Sustainable Technologies skill are, in fact, needed in the near future according to the survey. Respondents expect to hire a collective total of 114 persons with SusTech skill within the next five years.

A five-year demand for 114 new employees computes to an "annual" projected need for 22.8 new hires a year (114 divided by 5 = 22.8). This number compares favorably to the potential capacity of a MIST program for preparing 16-20 new employees per year (with a class size of 16-20 students).

(Note: Extrapolation that the employment demand is greater than 23 is not appropriate in this methodology, since the entire population -- and not just a sample -- of potential employers on Maui was surveyed.)

Number of Hiring Companies. An interesting result comes from inspecting the high concentration of affirmative responses to this item. Of the 54 businesses completing the questionnaire, 34 responded affirmatively that they would hire additional staff with SusTech skill over the next five years. That is, two-thirds of the responding companies expect to hire in this area in the immediate future.

Replacement vs. Expansion. Expansion accounts for about half (53, 46%) of the anticipated hires, and replacement for the other half (61, 54%). Despite a recent downturn of the economy, some companies are expecting expansion in this area.

Type of Hiring Companies. Where might persons with SusTech skill find jobs? Table 1 answers this question by breaking out the responses by business sector. All sectors surveyed expect to hire new SusTech employees.

Three sectors will demand large numbers of new hires: Electrical contractors (36), Plumbing (22), and Hotels (25). This result suggests a focus for the curriculum. It is also interesting to note that these three sectors will generate jobs for different reasons: Plumbing requiring persons primarily for Expansion; Hotels primarily for Replacement; and Electrical requiring Expansion and Replacement almost equally.

B. Hourly Wage for SusTech Hires

The questionnaire also asked companies planning to hire employees with SusTech skill what wage they are willing to pay. This result is summarized by Table 2.

Table 2
Hourly Wage for New Hires with SusTech Skill

Sector (No.)	min($5.25)	$5.30-8.00	$8 - 15	$15 - 25	$25+
Building	0	0	2	2	0
Electrical	0	0	4	5	4
Plumbing	0	0	3	2	1
Architects	0	0	1	2	0
Power	0	0	1	0	0
Hotels	0	0	5	3	4
Auto	0	0	1	1	0
Misc	0	0	6	0	0
Total (47)	**0**	**0**	**23**	**15**	**9**
Percent	--	--	**49%**	**32%**	**19%**

A minimum wage was proposed by none of the companies anticipating to hire persons with SusTech skill, nor was a wage ranging between $5.30 and $8.00 per hour. All respondents professed at least $8.00 per hour as a starting wage. Indeed, more than half (51%) claimed as much as $15 or more per hour. In fact, nine companies (19%) claimed they would start SusTech employees at $25 per hour, or more. The MIST program has the potential for preparing students for high-end jobs.

Hotels and Electrical Firms to Pay the Most. The two dominant sectors proposing $25+ per hour were Hotels and Electrical contractors.

There is variability within the sectors, however. For example, some hotels would start SusTech hires at $25 per hour, while about the same number of hotels would start them at half that rate. The variability may reflect the diverseness of companies that serve the small population base on Maui, or possibly a less than static economic situation. The response rate to this item is also relatively low, which could account for some of the apparent variability.

C. Differential Wage Paid for Sustainable Technologies Skill or Formal Training

Another question assessed whether companies do or would pay a differential wage to employees with SusTech skill or with formal SusTech training; and if so, then how much is the differential. Table 3a summarizes the responses regarding SusTech skill, and Table 3b summarizes those for SusTech training.

Seventeen (17, 32%) companies stated that they would pay a differential wage for SusTech skill, and 25 (46%) said they would not. Twelve (12) companies left an item blank because to them the item may not have been applicable, or because they were not willing to reveal their intention. (Note: As before, no importance can be placed on the large number leaving an item blank because of the strategy to include every possible business on Maui that might need SusTech employees, thus enhancing the opportunity to include "not applicable" in the sample.)

As for formal SusTech training, there were seventeen (17, 32%) respondents who said they would pay a differential wage. Another 23 (43%) said they would not. And 14 respondents left the item blank.

Companies Giving Wage Differential. SusTech skill would lead to better wage in most sectors. Only the three responding Power companies failed to quote a differential, with one citing the union contract. As for SusTech training, data were about the same.

Wage Differential Amount. The differential amount varied considerably across companies. Although $1-2 extra was the norm, some would pay up to $4 more per hour for SusTech skilled/trained employees.

Table 3a
Differential Wage for SusTech Skill

Sector (No.)	Yes	No	Blank/NA	Per Hour More
Building (7)	2	4	1	$2
Electrical (12)	4	5	3	$2, 1, 1, 1 NA: based on skill level.
Plumbing (6)	3	1	2	Y: depends.
Architects (4)	2	2	--	$0.50
Power (3)	--	2	1	N: not allowed under ILWU contract.
Hotels (11)	1	8	2	N: probably not.
Auto (3)	2	1	--	$3
Misc (8)	3	2	3	$2, N: cannot.
Total (54)	**17**	**25**	**12**	
Percent	**32%**	**46%**	**22%**	

Table 3b
Differential Wage for SusTech Training

Sector (No.)	Yes	No	Blank/NA	Per Hour More
Building (7)	2	4	1	$2
Electrical (12)	5	5	2	$4, 2, 1, 2, NA: based on skill level.
Plumbing (6)	3	--	3	Y: depends.
Architects (4)	1	2	1	$0.50
Power (3)	--	2	1	N: not allowed under ILWU contract.
Hotels (11)	1	7	3	N: probably not.
Auto (3)	2	1	--	$3
Misc (8)	3	2	3	$2; 15-20%
Total (54)	**17**	**23**	**14**	
Percent	**32%**	**43%**	**26%**	

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D. Preference Given for SusTech Skill in Hiring, Promoting, or Retaining Employees

Whether companies are willing to give preference to SusTech skill in hiring, promoting, or retaining employees was assessed and reported in Table 4 below.

A clear preference is found for SusTech skill in personnel actions. Preference was cited by more than two-thirds (69%) of those responding, and the preference was found in all sectors. One reservation some businesses expressed is that they would give preference only if other job skills are also good.

Table 4
Preference Given in Hiring, Promoting, or Retaining SusTech Employees

Sector (No.)	Yes	No	Blank	Specify *
Building (7)	3	3	1	
Electrical (12)	9	3	--	a, b, c, d
Plumbing (6)	5	--	1	e, f
Architects (4)	4	--	--	
Power (3)	3	--	--	g
Hotels (11)	6	2	3	h, i
Auto (3)	2	1	--	
Misc (8)	5	1	2	j
Total (54)	**37**	**10**	**7**	
Percent	**69%**	**19%**	**13%**	

*Specify --
(a) Y: I sure would.
(b) N: must be multi-talented just to have a job. This would be in the "total persons package."
(c) Y: if other trade proficiency level was also good.
(d) Y: hands on knowledge skills.
(e) Y: if applicable.
(f) Y: depends on job opportunities.
(g) Y: if they better meet job requirements.
(h) Y: all other being same.
(i) Y: hiring/promoting.
(j) Y: possibly.

E. Demand for In-Service Training

Another reason for a MIST program, in addition to the primary goal of pre-service training to prepare workers with Sustainable Technologies skill, is to provide in-service training and skill upgrading for employees already working in the field.

The survey assessed the employment demand for SusTech in-service training with Question #1, which asked respondents to estimate the number of employees in their firm (including themselves) who could benefit from courses in specific areas of Sustainable Technologies. Results to this item are summarized by Table 5.

The demand for in-service in Sustainable Technologies is quite large. Respondents claimed enough employees would benefit from taking SusTech courses to fill 597 seats.

High Demand In-Service Courses. The subject area with the strongest demand from respondents is Construction: New Materials and Methods. Respondents indicated a collective total of 103 employees who would benefit from training in this area.

Other subjects showing a strong demand are: Photovoltaic Design/Installation (90), Demand-Side Management (85), and Power Production/Management (94).

All other areas received interest as well.

Companies Generating In-Service Demand. The largest demand for in-service came from three sources: the 11 Hotels that completed the survey, suggesting enough employees would benefit from training to fill 137 seats; the three Power companies, also suggesting 137 seats; and the 12 Electrical contractors at 198 seats. These three sectors should be targeted for in-service training. The lowest demand came from Automotive (2).

Table 5
Number Employees Might Benefit from Sustainable Technologies Courses

Sector (No.)	Const Meth	Veh Fuel	Photo Volt	Solar Thrm	Bio mass	Wind Pwr	Wste Wtr	Dmnd Mgt	Pwr Prodn	Other	Over all
Building	18	2	1	1	--	2	2	--	--	--	26
Electrical	24	19	40	15	5	24	5	29	36	1	198
Plumbing	7	1	10	12	5	--	5	2	--	--	42
Architects	5	--	6	6	--	5	4	--	1	--	27
Power	15	14	25	10	15	14	2	10	32	--	137
Hotels	30	4	3	3	8	3	22	42	22	--	137
Auto	--	1	--	--	--	--	--	--	--	*1	2
Misc	4	3	5	3	3	2	3	2	3	--	28
Total	**103**	**44**	**90**	**50**	**36**	**50**	**43**	**85**	**94**	**2**	**597**

*Note.--Whenever a respondent x'd an item instead of indicating the "number" of employees who would benefit from a class, this analysis added "1" for the "x" in computing the total, even though the intended number of employees might be much higher. As such the actual totals may be higher than reflected.

**Note.--Other subject areas suggested were: Submetering-KWH/Water/gas (1); Automotive (1).

F. Recent Employee In-Service

Those surveyed were also asked to indicate whether they or their employees had received SusTech training within the past year, results of which are described in Table 6.

Table 6
Firms with Employees Receiving Sustainable Technologies Training

Sector	Topic(s)	No. Hr. per Employee	No. Employee	Where	Who
Electrical	Demand-side mgt, photovoltaic systems	10	3		
Electrical	Various Act energy Sys	6	1	Wailea	MECO
Electrical	Utility Workshops			MECO	MECO
Electrical	Code;elec competence			MCC	Wilhelm
Electrical	Electrician, computer	4		MCC	
Electrical	Electrical code			California	NFPA
Plumbing	--	40	1	Honolulu	USC
Architecture	Bamboo/cultivation & construction		1	Hilo	HC&S
Power	Demand-side mgt	24	5	Honolulu	Utility
Hotel	Demand-side mgt	4	10	Daily Mtgs	R.Hoonan,Dir Eng
Hotel	Electrical, water		4	on-site	MECO/Rocky Mountain Inst
Hotel	Recycle, electrical, demand mgt				
Auto	Automotive repairs	40	4	Los Angeles	Goodyear
Auto	Auto tech		4	Maui	MCC
Auto	Recycling wastes	.5	34	on-site	Owner
Misc.	Perma culture		10		

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A very interesting disparity emerges by comparing responses to Tables 5 and 6. While many companies expressed the need for employees to have SusTech in-service, Table 6 shows few companies report having employees who actually received training in the past year. Replying in the affirmative were just 16 firms, about 30 percent of the respondents. Yet the 30 percent figure is higher than that found in other Needs Assessments conducted recently, reflecting a higher level of activity in the SusTech area.

Little of this training was provided by MCC. The sector reporting the most in-service was Electrical Contractors.

G. Best Time for In-Service Classes

The survey assessed the potentially best time for offering in-service classes with the item, "When would you or your employees most likely take advantage of courses in Sustainable Technologies? (Check all that apply.)" The results are tabulated below in Table 7.

Table 7
Best Times for In-Service Classes

No. companies selecting Mornings	8
No. companies selecting Afternoons	6
No. companies selecting Evenings	47
No. companies selecting Saturdays	19

Evening Classes. The preference for evening classes is quite clear-cut. Most respondents expressed interest for in-service classes scheduled in the evenings, with 47 companies responding favorably toward this.

Saturday Classes. Saturday classes were a far less popular option, with only 19 companies opting for this (and most of them checked the Evening option, too).

Morning Classes. The companies which said their employees are likely to take advantage of SusTech courses in the day numbered only eight.

Afternoon Classes. Afternoon classes received the least support, with only six (6) companies selecting this option (and most chose other times as well).

Clearly any Sustainable Technologies instruction at Maui Community College intended for in-service should take place in the evenings.

H. Commentary

One of the last questions queried participants on what prospective new occupations in SusTech are emerging on Maui. A wide array of suggestions were offered, including those researched in the survey, especially Solar, Demand-Side Management, and Photovoltaics. The reader is encouraged to read the verbatim comments recorded in the section: Responder Comments.

The final question was an open-ended item asking for "Other Comments." The few comments made are recorded in the Responder Comment section for reader perusal.

SYNOPSIS

A community needs assessment to ascertain the employment demand on Maui for persons with SusTech skill was distributed to 500 business firms in electrical, plumbing, building, power, waste disposal, agriculture, architects, hotels, and automotive repair. Results based on 54 respondents gave evidence that the projected need for hiring new employees with SusTech skill is about 22.8 per year over the next five years (totaling 114 hires). Roughly equal numbers are projected for expansion (53) and replacement (61). A conclusion of this finding was that the anticipated employment demand on Maui for SusTech employees (22.8 per year) justifies the need for a MIST program with a capacity for training 16-20 students per year.

The firms expecting to hire numbered 34 and they spread across all business sectors surveyed. Three sectors (Electrical Contractors, Plumbing, Hotels) will generate many of the jobs, suggesting a focus for the curriculum in these areas.

The starting wage for SusTech hires was considerably above the minimum wage, with all respondents regardless of sector professing at least $8 per hour, and half promising $15 or more per hour. Saying they would pay a differential wage for SusTech skill were 17 companies, the same number (17) for SusTech training. Even more companies expressed preference in the personnel decisions of hiring, promoting, or retaining to employees with SusTech skill -- in fact, two-thirds of those responding (37, 69%) expressed this preference.

The in-service demand was quite high, although the reported track record was low by comparison. Many respondents claimed employees would benefit from SusTech training, enough to fill more than 597 seats. But just 16 firms said their employees had taken related in-service in the past year. The expressed need for training cut across many sectors, with Hotels, Power companies, and Electrical contractors generating the largest single need. The subject area generating the most interest was Construction: New Materials and Methods, although interest was evident in all other areas as well. The best time for classes is evenings.

These results support development and initiation of a MIST program to address the employment need emerging across many sectors of pre-service and in-service training for high-end jobs on Maui.

RESPONDER COMMENTS

What prospective new areas/occupations in Sustainable Technologies are emerging on Maui?

BUILDING CONTRACTORS
Design of homes using sustainable tech -- design, materials and systems.
I cannot fill this out because I am not a company, but I commend you in your efforts to promote and educate the public in sustainable resources. All sounds interesting to me and I look forward to the growing curriculum at MCC, especially within the environmental field. Mahalo.

ELECTRICAL CONTRACTORS
Alternative Transportation (electric cars, biodiesel, methane gas).
We need solar like Barstow, California project on wind, maybe waves.
Solar Electricity Generation, Solar Water pumping.
Solar electrical production, electrical xx.
Cogen by hotels -- this is more of an alternative power source -- wind, biomass, solar.
Photovoltaics design/installation.
Applying Demand-Side Management to mid and large electrical consumers.
Not much.
Energy efficient power and lighting design, fiber optics, CAT S cabling.

PLUMBING AND MECHANICAL REFRIGERATION, AC
Solar water heating due to MECO rebate program.
Solar heating/biomass.
Photovoltaic technicians, Fuel cell technicians.

ARCHITECTS
Bamboo cultivation (Sp. Goadua Augustafolia) for structural construction material.
Recycling of usable building materials.

POWER GENERATORS
Solar Photovoltaic, Demand-Side Management.

HOTELS
Construction, Agriculture, Demand-Side Management, Biomass, Gasification, Recycling.
Co-generation/alternative energy sources.
Deep water cooling systems - Co-Geo grid systems.
Co-generation technology/alternative fuel source power generation/aqua culture/composting.
Not sure.

AUTOMOTIVE
Computer, Sales & Marketing, Solar.

MISCELLANEOUS
Alternative materials, alternative waste, gray water systems, demand-side management, pv systems design.
Biomass and wind.
Lumber.
Alternative fuel-biodiesel S.

Other comments:
Offer more classes in electrical, plumbing, auto, and building trades.
Thank you.
No comments.
Place some of your trainees with the solar water heater contractors. They need help right now.
Very interesting.

APPENDIX A
Developers of the SusTech Needs Assessment

MIST Advisory Committee:

Jim McElvaney, Sustainable Technologies, Inc.
Kalvin Kobayashi, County of Maui, Office of Economic Development
Nicolas Oosterveen, Nick Oosterveen Designs, Inc.
Mark J. Andrews, Office of Technology Transfer
Robert J. Kwok, HC&S, Production & Maintenance
Henry Lindsey, Lindsey Building & Co. & Maui Contractor's Association
Hugues Ogier, Energy Services Division, Maui Electric Company
Dick Doran, Aloha Plastic Recycling, Inc.
Mike Williams, Valley Isle Building Supply
Larry Zolezzi, Pacific BioDiesel

MIST Coordinator: Don Ainsworth

Division Chair for Vocational Technical: Dennis Tanga

Director of Rural Community Leadership: Jane Yamashiro

Assistant Dean of Instruction: Jean A. Pezzoli, Ph.D.

Dean of Instruction: Liz d'Argy

APPENDIX B-1

Maui Community College
UNIVERSITY OF HAWAI'I
SUSTAINABLE TECHNOLOGIES

Survey on Maui County Needs
for Education and Training in Sustainable Technologies

Sustainable Technologies: A program designed to educate a workforce for businesses involved in alternative methods for meeting long term energy needs on Maui and in the State of Hawaii. This approach involves utilizing alternative resources including demand-side management, solar and wind energy, biomass, energy production/management and alternative transportation fuels.

1. Estimate the number of employees in your firm (including yourself) who could benefit from courses in these areas of Sustainable Technologies:
   ___Construction, Alternative Materials and Methods
   ___Alternative Transportation Systems (electric cars, biodiesel, methane gas)
   ___Photovoltaic System Design/Install
   ___Solar Thermal System Design/Install
   ___Demand-side Management
   ___Biomass Systems
   ___Power Production and Management
   ___Wind Power System Design/Install
   ___Alternative Waste/Gray Water Systems
   ___Other _____

2a. In what type of business activities are you involved?

___Construction	___Power Generation	___Biomass Gasification
___Biomass Power	___Anaerobic Digestion	___Alternative Fuels
___Hotel	___Electrical	___Solar Thermal Apps
___Agriculture	___Architectural Design	___Horticulture Design
___Demand-Side Mgmt	___Recycling	___Composting
___Permaculture	___Aquaculture	___Other: specify_____

2b. What is the size of your company: ___number of employees

3. If you or your employees received Sustainable Technologies related training within the past year, specify the area(s):

310 Kaahumanu Avenue • Kahului, Maui, Hawai'i 96732 • Phone (808) 984-3384
An Equal Opportunity Employer/Affirmative Action Institution

Maui Community College
UNIVERSITY OF HAWAI'I

Survey on County Needs for Education and Training in Sustainable Technologies

Sustainable Technologies: A program designed to educate a workforce for business involved in alternative methods for meeting long term energy needs on Maui and in the State of Hawaii. This program involves the use of resources including demand-side management; solar, wind,water & biomass energy production & management; and alternative transportation fuels.

Please help use by completing & returning this survey by July 1, 1997. Thank you.

1. How many employees in your firm could benefit from courses in the following areas:
__ Construction (new materials & methods)
__Vehicle fuel (electric, biodiesel, methane)
__Photovoltaic system design/install
__Solarthermal system design/install
__Biomass systems
__Windpower system design/install
__Waste/gray water systems
__Demand-side management
__Power production and management
__Other_____

2. What Sustainable Technologies related training have your employees received within the past year, specify the area(s):
_____

Number of employees __ hours/employees
Where was training held_____
Who was sponsor/trainer_____

3. Number of employees_____

4. Your business activity area(s)
__Construction __Power generation
__Biomass power __Anaerobic systems
__Alternative fuels __Hospitality
__Electrical __Solar thermal
__Agriculture __Architectural
__Horticulture __Demand-side mgt.
__Recycling __Composting
__Permaculture __Aquaculture
__Other _____

5. When would you or your employees most likely take advantage of courses in Sustainable Technologies
__a.m. __p.m. __evenings __saturdays

6. In the next five years, how many staff with Sustainable Technologies skills to you expect to hire (give number)
__due to expansion __due to replacement

at what hourly rate of pay
__minimum wage ($5.25) __$5.30-$8.00
__ $8.00-$15.00 __$15.00-$25.00 __$25+

7. Do you/would you pay a differential wage to your employees with sustainable:

Skills __yes __no $___ per hour more
Training __yes __no $___ per hour more

8. Do you/would you give preference in hiring promoting or retaining to employees with Sustainable skills? __yes __no

9. What new areas in Sustainable Tech. are emerging on Maui _____
_____
Other comments:_____
_____
_____

APPENDIX B-2

MAUI COMMUNITY COLLEGE
SUSTAINABLE TECHNOLOGIES

Please take a few minutes to complete this survey form. Our planned course of instruction in Sustainable Technologies depends upon verifying that the skills necessary to design, install and service the emerging technology systems are needed in the workforce on Maui. Just re-fold and tape this form with our return address on the outside and mail (no postage required). Thanks you.

If you have any questions, or would like to visit our program on campus, please call Don Ainsworth at 984-3384.

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Appendix D

Indication of Student Demand

Some indication of student interest for a new program may be estimated before its implementation because the University allows the offering of three courses from a department on an experimental basis. Such enrollments are delimited, however, by the fact that students are precluded from selecting that major before the program are approved and thereby are ineligible for financial aid. A second strategy for assessing potential program enrollment is to offer selected courses from related curricula that are updated and customized with a sustainable technology focus. These have included certain courses from Building Maintenance and several from Carpentry Technology which enabled preparation of building eco-cottages on the campus and at the Molokai Farm, as well as hands-on projects retrofitting at the Lanai and Hana Education Centers.

Semester	*Course*	*Title*	*Enroll*	*Site*
Spring 1998	ENRGY 197	Intro to SUSTECH	4	Campus
Spring 1998	ENRGY 198v	Intro to SUSTECH	0	Campus
Spring 1998	MAINT 151v	Work Practicum	13	Hana
Spring 1998	MAINT 151v	Work Practicum	15	Lanai
Spring 1998	ELEC 101	Electric Technology	5	Molokai
Fall 1998	ENRGY 197	Intro to SUSTECH	19	Hana
Fall 1998	ENRGY 197	SUSTECH Systems	19	Hana
Fall 1998	ENRGY 197	Intro to SUSTECH	15	Lanai
Fall 1998	ENRGY 197	SUSTECH Systems	15	Lanai
Fall 1998	ENRGY 197	Intro to SUSTECH	10	Molokai
Fall 1998	ENRGY 197	SUSTECH Systems	10	Molokai
Spring 1999	ELEC 23	Electrical Wiring	7 *	Hana
Spring 1999	ELEC 23	Electrical Wiring	10	Lanai
Spring 1999	MAINT 151	Work Practicum	7 *	Molokai
Spring 1999	ELEC 23	Electrical Wiring	10	Molokai
Fall 1999	MAINT 20	Intro to Maintenance	17	Molokai
Fall 1999	MAINT 40	Painting & Decorating	16	Molokai
Spring 2000	ELEC 23	Electrical Wiring	17	Molokai
Spring 2000	MAINT 50	Plumbing	17	Molokai
Spring 2000	MAINT 30	Masonry	17	Molokai
Fall 2000	CARP 20DE	Hand & Power Tools	13	Molokai
Spring 2001	CARP 41E	Wall & Ceiling Framing	9	Molokai
Total			265	

Note.-- Class max is 15 students for theory classes; internship (*) workload was 1 cr. per 5 students.

Appendix E

Sustainable Technology Faculty

The demand for Sustainable Technology courses which is anticipated over the immediate 5-year planning period will be met with instructional resources of 1.5 faculty positions supplemented by 2-4 lecturers per academic year.

- A conversion of the 1.0 Carpentry Technology position is pending approval. The position was vacated at the recent retirement of the Carpentry instructor. The Carpentry Technology program will undergo restructuring to address technological changes and declines in program enrollments.

- The Building Maintenance program is also experiencing enrollment declines and curriculum updating in light of changes toward sustainable building management. Numerous courses from that curriculum will assume a Sustainable Technology format, applying a 0.5 portion of the Building Maintenance position to support the Sustainable Technology curriculum.

- With approval of the Sustainable Technology curriculum and as program enrollments grow, it is anticipated that the College will need to hire 3-4 lecturers per academic year. These resources will be covered initially from within current College lectureship budget, and subsequently as enrollments further grow through reallocation or supplemental funding.

Appendix F

Planned Resources

Cost Item	*2001-02*	*2002-03*	*2003-04*	*2004-05*	*2005-06*
SUSTECH Instructor	37,464	38,213	38,978	39,757	40,552
SUSTECH Lecturers	-	3,000	5,000	7,000	9,000
Supplies	1,000	1,200	1,200	1,200	1,200
Equipment	-	-	-	-	-
Total	**38,464**	**42,413**	**45,178**	**47,957**	**50,752**

Explanatory notes:

1. Instructor salary based on 1.0 FTE, 11-month instructional position at base salary step.
2. Salary increases assume an annual increase of 2 percent after 2001-02.
3. Lecturer cost assumes hiring an increasing number of lecturers for conducting internships both on campus and in outreach to handle program extension and expansion.
4. Supply and equipment costs assume recoup of building materials and demonstration equipment through grants and sale of eco-cottage. Dollars shown are for general office and classroom supplies like Xeroxing, maintenance contracts, etc.

Appendix G

Projected Assessment of Program Efficiency

Measure of Efficiency	*2001-02*	*2002-03*	*2003-04*	*2004-05*	*2005-06*
Average Class Size: Fall	14	20	25	28	30
Average Class Size: Spring	15	20	25	28	30
Average FTE Majors/semester	30	40	45	50	55
Student-Faculty Ratio/Lecture	14 to 1	20 to 1	25 to 1	25 to 1	30 to 1
Student-Faculty Ratio/Internship	14 to 1	15 to 1	15 to 1	15 to 1	15 to 1
Annual Faculty credit load	30	30	30	30	30
Annual SSH	420	600	750	840	900
Projected Annual Cost	$38,464	$42,413	$45,178	$47,957	$50,752
Projected Cost/SSH: Annual	$92	$71	$60	$57	$56
Projected Cost/SSH: Semester	$46	$35	$30	$29	$28

Projection assumptions:

1. All classes full.
2. Faculty load will be only in the program.
3. Class size increases due to lecture component adding outreach students through distance delivered classes beginning 2002-03.
4. Majors attend full and part time.
5. Internships pay based on one credit per five students.
6. Total SSH based on student SSH for Fall and Spring Semesters.

Appendix H

Comparative Costs per SSH

PROGRAM	*Cost**	*SSH***	*Cost/SSH*
Business Careers	35,127	1566	22
Etron-Computer Engineering Tech	86,599	1390	62
Hotel Operations	29,262	449	65
Accounting	73,479	726	101
Auto Body	22,788	142	101
Welding	4,215	41	103
Fashion Technology	25632	226	113
Human Services	52,633	437	120
Office Administration & Tech	105,135	850	124
Administration of Justice	27,648	201	138
Automotive Technology	49,209	353	139
Food Service	173,864	1184	147
Carpentry/Drafting	24,992	159	157
Building Maintenance	37,467	154	243
Nursing	385,836	1232	313
Agriculture	76,724	232	331
Totals/Average	*1,210,610*	*9342*	*130*

Notes:

*Source: Program Operating Resources Summary, Office of the Dean of Instruction, Fall 2000.

**Source: Course Enrollment Report, UH IRO, Fall 2000.

Appendix I

Community Advisory Committee

Mark Andrews	Associate Director Maui Research and Technology Center
Dick Doran, Chair	President Aloha Plastic Recycling
Brian Kealoha	Account Representative Energy Services Division, Maui Electric
Kalvin Kobayashi	Energy Coordinator County Office of Economic Development
Robert J. Kwok	Vice President Production and Maintenance, HC&S
Nick Oosterveen	Owner/Operator Nick Oosterveen Designs, Inc.
Tom Reed	President Aloha Glass Recycling
Mike Williams	Department Manager Miyaki Concrete Accessories, Inc.
Larry Zolezzi	Controller Pacific BioDiesel

Appendix J

Community Letters of Support

JAMES "KIMO" APANA
MAYOR

GRANT Y.M. CHUN
MANAGING DIRECTOR
TELEPHONE: (808) 270-7855
FAX: (808) 270-7870

DEPARTMENT OF MANAGEMENT

COUNTY OF MAUI
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII USA 96793-2155

March 15, 2001

Mr. Clyde Sakamoto, Provost
Maui Community College
310 W. Kaahumanu Avenue
Kahului, HI 96732

Dear Mr. Sakamoto:

I am continually amazed at the forward-thinking leadership and the high level of professionalism demonstrated by your college's sustainable technologies program. Accordingly, I ask for your continued support for this program and to establish an AAS Degree in Sustainable Technologies.

Sustainable energy technologies will play a crucial role in strengthening Maui County's economic competitiveness. High technology users and industries are increasingly requiring advanced power systems to meet stringent power quality and reliability demands. A high tech energy infrastructure is needed to support Maui's growing high tech economy and I believe your sustainable technologies program is a vital component of a high tech energy infrastructure.

Sustainable energy technologies will also play a critical role in enhancing our environment and quality of life. New energy efficient technologies, renewable energy systems, and clean distributed power systems will lower consumer costs, reduce toxic emissions and greenhouse gasses, and mitigate the chances of oil spills.

I believe that Maui Community College's sustainable technology program is important to Maui's economic and environmental future and therefore, I offer you my continued support and hope you will also continue supporting this program and institute an AAS Degree in Sustainable Technologies.

Sincerely yours,

Kalvin K. Kobayashi
Energy Coordinator

Quality Seamless Service – Now and for the Future

Grand Wailea Resort
HOTEL & SPA
Maui, Hawaii

March 14, 2001

Clyde Sakamoto
Maui Community College
310 Kaahumanu Avenue
Kahului, HI 96732

Dear Provost Sakamoto:

I understand that Maui Community College is submitting a program proposal to the Board of Regents to get approval for an associate of science degree in sustainable technology. As a former student at MCC in your Building Maintenance program with Mark Slattery, I am well aware of the important role the college has in preparing our work force in their chosen careers.

On many occasions, I have had the opportunity to learn about the Sustainable Technology program, the last time being a few months ago when Don Ainsworth and I met and discussed the Maximo software for computerized control of facility maintenance at MCC and our Hotel.

Escalating costs make energy management and alternative energy sources a substantive part of effectively managing our operations costs and the future need for qualified personnel in both areas is certain.

Congratulations on the job you and your staff are doing at the college.

Sincerely,

Robert Hoonan
Director of Engineering

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3850 Wailea Alanui, Wailea, Maui, Hawaii 96753
Guest phone: 808-875-1234 Fax: 808-879-4077 Toll free reservations: 800-888-6100
Sales & Marketing: 808-874-2422 Fax: 808-874-2411 email: info@grandwailea.com web site: http://www.grandwailea.com

ALOHA PLASTIC RECYCLING INC

Post Office Box 1429
Puunene, HI 96784
(808) 877-0822
Fax (808) 877-2503

March 15, 2001

Clyde Sakamoto
Maui Community College
310 Kaahumanu Avenue
Kahului, HI 96732

Dear Provost Sakamoto:

As a member of the program advisory committee, I am aware that Maui Community College is submitting a program proposal to the Board of Regents to get approval for an associate of science degree in sustainable technology.

In addition to my relationship with the faculty and administration at the college with respect to the program, I have been involved with MCC interns to develop a new product using our recycled plastic.

The interns came to us with the idea to fabricate foundation blocks from our plastic to replace those used in residential construction which are made from concrete. The resulting product is stronger than concrete, weights approximately one-half as much, and removes forty pounds of plastic from the landfill for every block produced.

Utilizing recycled and recyclable materials and availing ourselves of alternative energy sources demand that we have trained technicians now and in the future.

Good luck in the approval process..

Sincerely,

Tom Reed,
Sec. / Treasurer

March 8, 2001

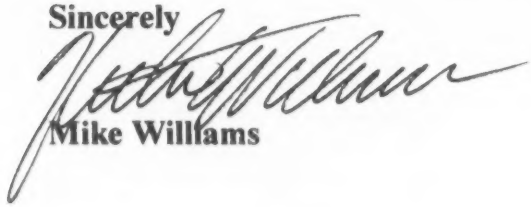
Mr. Clyde Sakamoto Provost
Maui Community College
310 Kaahumanu Ave
Kahului Hi. 96732

Dear Mr. Sakamoto:

I have been working with your staff for over four years in helping to locate and supply recycled and recyclable materials for the MIST program, ecocottage design and construction. This program is surely needed in our county and I have been proud to be a part of it.

Thank you for the continued support of this program.

Sincerely



Mike Williams

PACIFIC BIODIESEL, Inc.
285 Hukilike Street, B-103
Kahului, Hawaii 96732
(808) 877-3144
(809) 871-5631 Fax

PACIFIC BIODIESEL, Inc.

March 8, 2001

Clyde Sakamoto
Maui Community College
310 Kaahumanu Ave.
Kahului, HI 96732

Dear Provost Sakamoto,

This letter is to add my support to the establishment of the Sustainable Technology as a degree granting program. At Pacific Biodiesel, we are involved in the recycling of used cooking oil by converting it to use as diesel fuel. This new project makes use of a waste product and creates a safe, biodegradable, significantly less polluting fuel which is used in transportation, tour buses and boats, and energy production.

Pacific Biodiesel, a Maui business, has been a pioneer in alternative fuel production and sustainable technology. What we have experienced is a serious need for more education, information, and effort in this field. We see unlimited opportunity.

The Sustainable Technology program will be an important part of our future in clean, renewable energy production.

Sincerely,

Larry Zolezzi
Secretary/Treasurer
Pacific Biodiesel, Inc.

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